1 Engage

2 Justify

3 Implement

4 Sustain

Case Studies

Humble Lamppost

Case Studies

Packaged smart cities solutions

CONCEPT DOCUMENT

This is a 20% concept document. It includes only an excerpt of the full 20% draft, and is intended to provide an outline for key stakeholders

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1. INTRODUCTION

This document has been developed within the EU-funded 'SCC01 Lighthouse programmes' and European Innovation Partnership for Smart Cities & Communities (EIP-SCC) communities.

It is intended for use by the now >100 SCC01 cities and indeed any other city that may wish to implement smart lampposts. It has been prepared through the collective knowledge from Sharing Cities, other lighthouse programme partners, and broader market research. More information about the lighthouse programme here and EIP-SCC here

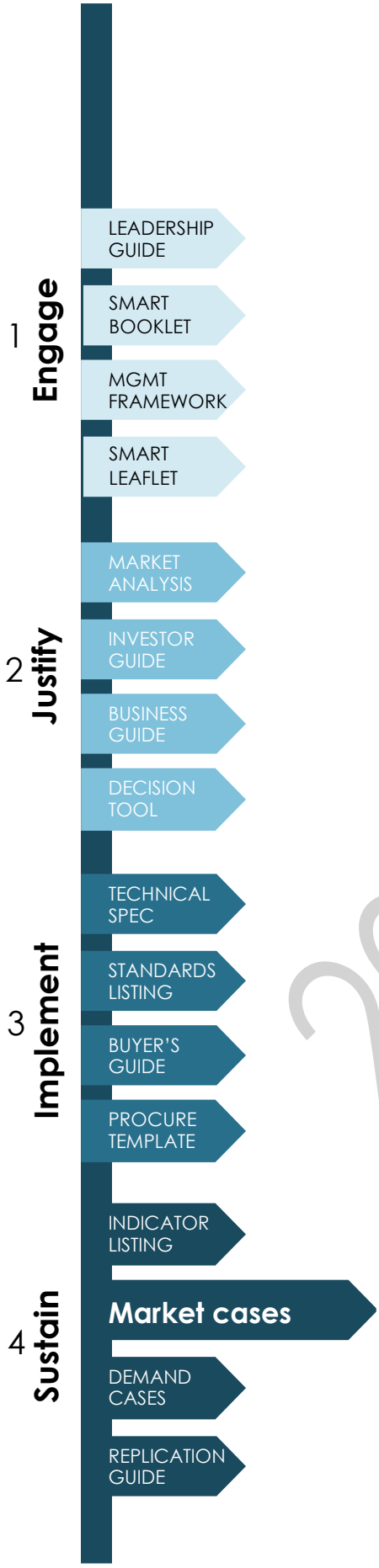
1.1 OBJECTIVES

The purpose of this inventory of case studies is to inform cities of real concrete examples of proven smart lamppost projects across a variety of geographies, cities, and use cases in order to provide a basis for inspiration, comparison and learning. It is structured to help cities look at similar contexts (in terms of size, geography and development) and understand the types of value – financial and non-financial – that can be accessed through upgrading lampposts to improve public realm and deliver a wider portfolio of services.

These case studies span scale LED upgrade through emerging scale value-added services. Upgrading lampposts to LED is a rapidly maturing market. The addition of a Central Management System (CMS) offers significant additional value in terms of optimising energy, improving control of light and achieving public safety goals. Most cities that have experience of CMS now recommend it to their peers. The suite of additional services that can be provided via the lamppost is considerable and experience is growing in terms of the value that can result.

The lighting energy efficiency and operational savings are well-proven, globally. The value of smart added services and data are increasingly being recognised, and much potential has yet to be uncovered. Experienced market experts have suggested that the ratio of value from LED upgrade only; to smart services; to the wider value that could be realised from the additional data generated could be in the order of a "1-5-10 value"

These case studies form part of the portfolio of packaging documents and tools.



1.2 'PACKAGING' OF SMART CITY SOLUTIONS

'Packaging' supports cities to help reduce the effort, speed the process, deliver greater c onsistency, and add value from idea through implementation to operations. The intention of packaging is to provide a portfolio of trusted familiar structured guidance for the variety of people and roles that will be involved. This will enable acceleration and scale up of smart city solutions and reduce risk by basing decisions and actions on tested methods.

Packaging comprises a portfolio of documents and templates that offer guidance and support on smart measures, based on the experience of the lighthouse programmes. For each measure packaging addresses (i) societal needs, (ii) technical options, (iii) business models and financing. Importantly, it also offers structured insight on the specific context of the cities, highlighting similarities and differences that can resonate with other cities' circumstances. This enables appropriate tailoring of solutions to local context. Packaging is therefore not a 'one-size-fits-all' approach; it is the application of component-based interoperable solutions to deliver affordable and better services in cities to maximise impact

Packaging has a growing portfolio that captures approaches, methods, tools and knowledge, to support a city throughout the entire life-cycle of a project; covering: engaging the audience, making the case, implementation, and sustaining value.

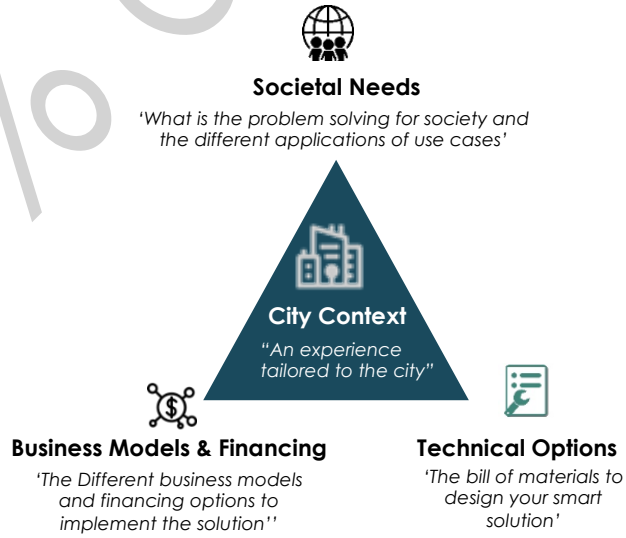


Figure 1: Packaging Framework

Packaging addresses the needs of different stakeholder groups: Political Leaders; Policy Advisors; City Officers; City Technicians; Procurement Officers; Advisors; Industry; Investors; and Citizens, as projects progress through their life-cycle stages.

The smart lamppost portfolio represents a growing number of documents covering these 4 project stages (table 1).

Table 1: Humble Lamppost Portfolio of Documents

Stage 1: Engaging Stakeholders	 **Leadership Guide** A 6-pages document clarifying for politicians and city leaders the opportunity of smart lamppost upgrade. Status: 80% draft	 **Smart Booklet** A 10page document targeted at the multiple city service owners that could benefit to provide a basic understanding of the key opportunities. Status: 80% draft
	 **Smart Leaflet** A 1-page brochure to raise awareness in the communities who live and experience the city. *Status: 80% draft*	 **Management Framework / 'Playbook'** Support the project lead to align and integrate across the various service lines to support end-to-end project delivery. *Status: 80% draft*
Stage 2: Making the Case	 **Decision Support Tool Guide** A digital online platform evaluating bankable smart lampposts projects directed for variety of cities decisions markers. *Status: 80% Draft*	 **Investor Guide** An easy read to raise confidence among investors and clarify the potential value of smart lampposts. *Status: 80% draft*
	Business Model & Financing Short Document capturing the different business models and financing options *Status: No draft*	 **Market Analysis** A quick read capturing the market context for a smart lamppost *Status: 100% (EIP-SCC)*
Stage 3: Implementation	 **Buyer's Guide** A market catalogue to inform cities on the different smart lamppost providers *Status: 20% Draft*	**Procurement Template** A Structured procurement template for use by buyer, however known by suppliers to help expedite and improve procurement process. *Status: No Draft*
	Functional Requirements & Technical Specification ~50-100 pages document on detailed specifications and tools; collaboration with BSI and 2 other national standard bodies *Status: Proposal out for sponsorship*	 **Standards Listing** Identify the various applicable standards for design and procurement *Status: 20% Draft*
Stage 4: Sustaining Value	 **Value Monitoring Indicators** Listing indicators (financial and non-financial) relevant for the Smart Lamppost *Status: 50% Draft*	**Replication and Scale Guide** Short 10-page guide including bench learning, collaboration and replication criteria. *Status: No Draft*
	Demand Aggregation Case Studies 10-20 pages documents to support market aggregation to access economies of scale and support replication from city to city *Status: No Draft*	 **Market Case Studies** 20-page structured document capturing different case studies to ensure awareness of market needs and innovation. *Status: 20% Draft*

2. SCOPE OF LAMPPOST UPGRADE

2.1 USE CASES

Seven broad categories of potential lamppost upgrade use cases have been considered as shown in figure 2:

- Lighting
- Connectivity
- Mobility
- Public Safety
- Digital Signage
- Energy
- Environmental

For each category, there may be a variety of more specific use cases; each requiring different equipment and operating procedures. And each delivers different forms of value.

These are elaborated further in other packaging materials.

As cities and industry innovate further, other use cases continue to emerge, for instance wind turbines, or drone recharging.

2.2 DEPLOYMENT TYPES

Typically, cities will consider **two types of deployment**. Firstly, **Lamppost retrofit** where they have existing columns that are in good condition and do not need replacing, they will change out the arm and luminaire to LED, and affix where desired additional equipment and sensors on the outside of the current column. Secondly, where columns may require to be replaced, where a range of additional use cases is desired, or for aesthetic reasons (e.g. high street) they may elect to install **multi-functional poles**, where the additional service components can be pre-assembled or easily integrated within the overall envelope of the column design. In most cities it is likely to be a combination both deployments knowing that most poles in Europe as an example are old and will have to be replaced at some point.

Lamppost retrofit
Adding new things into a existing asset

Multi-functional pole
Installing new smart integrated poles

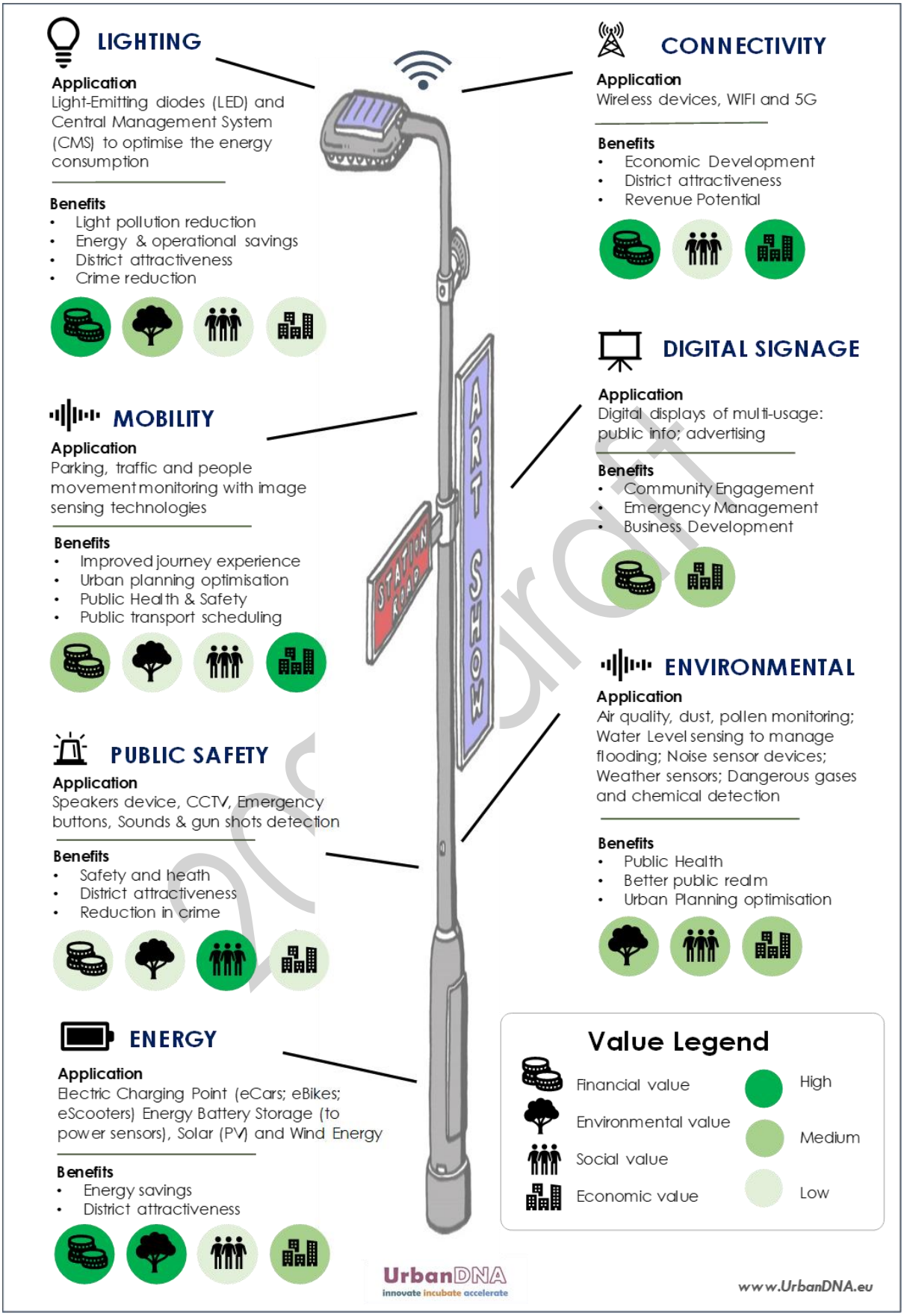


Figure 2 Smart Lamppost Value

3. CASE STUDY CAPTURE

3.1 IMPORTANT CONSIDERATIONS IN CAPTURING CITY CASE STUDIES

There are important aspects to consider when it comes to capture a city case study.

- **Fitting Solutions to Local Context:** this is central to the packaging concept, enabling a solution to be appropriately tailored to local conditions. A structured model is applied to profile the context of any city, which helps other cities compare context, thus be more informed when they evaluate how a city implemented a solution and what impact resulted. Every city around the world is different in terms of geography, size, typology, development, societal culture and norms, regulatory environment, policies, asset ownership, risk propensity, and other such factors. As such they all have specific needs and demands. This does not condone each city from starting their designs from first principles. By focusing on commonalities; taking a structured approach to profiling the context of a city; seeking to adopt or adapt solutions before creating anew; cities can compare in a more informed manner, and thus identify where solutions from other places can best be tailored to their local context. The packaging approach is based around a model that brings together (i) societal needs (ii) technical specifications and (iii) business models and financing, which helps this process of designing in a holistic manner and tailoring appropriately.
- **Balancing Scale Advantage with Risk and Uncertainties**: many cities have upgraded their lighting stock at very modest annual percentages, and as public budgets get more constrained other service choices often take priority to lighting upgrades. Upgrading at very modest levels delays access to the substantial benefits available. This, and also piloting of LED and smart features at small volumes, both reduce the potential to access economies of scale from the market. The combination can reduce and delay value unnecessarily. A balance must be struck between the advantages of scale and any uncertainty about technology readiness levels of product, or concerns within a city about capacity to specify appropriately. Collaboration amongst municipalities can help in this regard through sharing of expertise and resource. It can also increase scale and get considerably better financial terms from the market and more focus on innovation and quality product from industry. Bringing greater volumes to the market is also attractive to that same market.
- **Use Case Ambitions**: scope of implementations varies considerably across the seven use case categories discussed. The potential value (the "1:5:10" ratio) also varies accordingly. Undoubtedly LED upgrade alone offers substantial benefits in both financial and non-financial terms. The additional value from smart services and associated data is increasingly being recognised, and an increasing interest from cities is being shown to explore the potential from these new opportunities.

These three factors have been built into the process of researching and capturing information on the cases studies presented, and built into the case study template, in order to help inform an implementing city.

3.2 HOW THE CASE STUDY TEMPLATE IS STRUCTURED

Each case study is captured on an A4 page, providing consistent highlights as follows:

SUMMARY

A few lines summarising of the city case study, identifying particularly unique features, the main deployment and outcomes.

CITY CONTEXT

Summary text about the local context of the city or the local demonstrator if it's a district within a city (e.g. the administration considering a project) in terms of standing, history that influence the deployment of smart lamppost projects

Size	Economic Development	Politics, Policy Regulation	Culture & Social	City 'Physiology'
The size of the city in term of population within three levels: -**Size 1**: Less than 500,000 -**Size 2**: Between 500,000 and 2 million -**Size 3**: More than 2 million	The state of development of country according the UN broad classification -**Developed Economies**: cities in developing countries -**Economies in transition**: cities in emerging countries -**Developing Economies**: cities in developing countries	Key influencing factors for smart lamppost deployment in terms of politics, governance, regulation, policy, …	Key societal influencing factors in terms of people lifestyles, cultural heritage, demography, security, …	Key influencing factors for in terms of physical aspect e.g. climate; assets & infrastructures, Natural Assets

PROJECT

Use Cases	Scale 25%/50%/75%/100% or input # of unit	Implementation		
		Business Model- Ownership	Financing	Timing
The relevant use cases applied in the city based on the use case categorisation	Scale of use case deployment assuming 4 levels: 25%; 50%; 75%; 100%	The asset ownership, type of business model and operating structure, contract length adopted: e.g. concession and public asset ownership	The financing and funding sources, whether public or private or blended; and stated budget	Timeframe and duration of the project

OUTCOMES

Financial	Social	Environmental	Economic
indicate of value from 1 to 5 (5 being the highest) ★ compare to other outcomes	Ditto	Ditto	Ditto
Describe the key figures and outcomes in financial terms e.g. savings a year, pay back or revenues	Describe the key figures and outcomes in social terms e.g. health savings	Describe the key figures and outcomes in environmental terms e.g. Co2 savings	Describe the key figures and outcomes in economic terms e.g. local economy development, district attractiveness, these are indirect outcomes compare to financial ones.

KEY LEARNING

Key learnings from the project e.g. processes or decisions, stakeholder's engagement, technical knowledge

REPLICATION CONDITIONS

The particular conditions that could make this implementation most replicable in other cities e.g. public asset ownership; political support;

INFORMATION SOURCES

Referenced sources (web link, interview, or documents)

4. MARKET INSIGHTS

This section highlights the main insights from the market in terms of readiness.

4.1 DEMAND-SIDE MATURITY

LED upgrade progress ranges from single digit percentage to low double-digit percentage in most geographies around the world. That suggests considerable upside still to be captured from further LED upgrades.

LED technology is still evolving; efficiencies continue to improve; as well as knowledge about luminescence, colour temperatures, health effects and the like. Building this knowledge within the demand side is an important aspect to build confidence and stimulate adoption at scale.

Central Management System (CMS) adoption is now seen as th… …en performing LED upgrade at any scale, and affords additional … …dimming') of light levels to mitigate light pollution … …suring adequate and safe lighting …

NOTE
the full 20% document describes the market insights of different use cases

4.2 MAIN BUSINESS MODELS

Four business model options have been outlined (see figure 3), and these provide a pragmatic basis for cities to consider what is most appropriate for their setting.

Two trends are observed

- Firstly, and not in all geographies, a shift from low volume (i.e. <5% pa) annual 'maintenance upgrades' to significant volume upgrade. These on occasions also involve externalisation of responsibilities (and at times asset ownership or liabilities) through longer-term PPP contracts or similar.
- Secondly, the progressive adoption of smart services / multi-purposing of the lamppost, as new features mature and cities' move from experimentation to larger scale adoption. This brings with it a whole new conversation about value (savings, revenue, non-financial benefits).

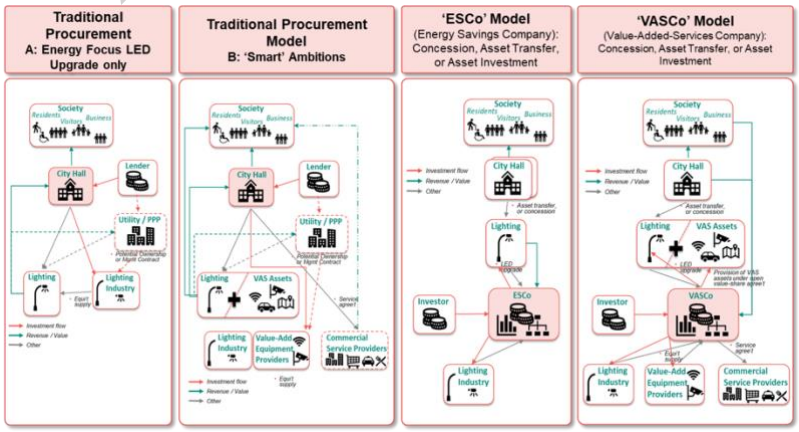


Figure 3 Business Models Smart Lamppost

5. CASE STUDIES

5.1 PORTFOLIO OF CASE STUDIES

Table 2: List of case studies in alphabetic order

Context				Use Case Category							
City	**Country**	**Development**	**City size**	**Lighting**	**Energy**	**Public Safety**	**Envir'nt Sensing**	**Signage**	**Mobility**	**Connect 'ty**	**MFP**
Birmingham	UK	Developed	1.1m	✓							
Boston	USA	Developed	0.7m	✓							
Bristol	UK	Developed	0.5m	✓			✓	✓		✓	
Burgas	Bulgaria	Developed	0.4m	✓	✓	✓			✓	✓	
Cairns	Australia	Developed	0.15m								
Chicago	USA	Developed	2.7m	✓						✓	
Copenhagen	Denmark	Developed	0.6m						✓		
Dunedin	NZ	Developed	0.1m	**City-wide**							
Hounslow	UK	Developed	0.27m	**City-wide**	✓	✓	✓	✓	✓	✓	
Kansas City	USA	Developed	0.5m					✓			
Lambeth	UK	Developed	0.3m								
Las Vegas	USA	Developed	0.6m								
Los Angeles	USA	Developed	4m								
Ludwigsburg	Germany	Developed	0.5m								
Lyon	France	Developed	0.5m	✓							
Madrid	Spain	Developed	6.5m								
Manchester	UK	Developed	0.5								
Milan	IT	Developed	1.3							**LoRA pilot**	
San Diego	US	Developed	1.4								

MFP: Multi-Functional Pole

NOTE
the full 20% document holds ~100 listed case studies with some captured in more detail, the highlighted (yellow) cities are captured as examples below

5.2 CASE STUDIES

5.2.1 Milan – Medium Size City, City Wide LED, Modest on Smart

SUMMARY

Milan undertook a city-wide roll-out of LEDs for ~140,000 lampposts under a concession arrangement from 2015-2018. Following LED upgrade, Milan as a 'lighthouse' city, has trialled connectivity for parking monitoring use cases, to commence post-LED 'smart' piloting.

CITY CONTEXT

Milan is the economic capital of Italy with strong capacity and international exposure.

Size	Development	Politics, Policy Regulation	Culture & Social	City Physiology
1.4 million	Developed Economies	Strong political support. Progressive innovative city.	Safe city. Strong car ownership. Medium data privacy sensitivity. Large cultural diversity. Tourist destination. EXPO Event.	Multiple historic districts. Pedestrian city centre. Modest density. Congestion. Paved Streets.

PROJECT

Use Cases	Scale 25%/50%/75%/100% or input # of unit	Implementation		
		Business Model -Ownership	Financing	Timing
☑ LED	100%	Concession – Public Owned	Public ~1million€	3 years
☑ CMS	25%	Concession - Public Owned	Blended	3 years
☑ Parking sensors	Pilots ~150	Concession to a2a Smart City - Public Owned	Blended 120k€ EU Fund / Private Investment 50k	3 years

OUTCOMES

Financial	Social	Environmental	Economic
★★★★	★	★★★	
52% energy cost reduction yearly **31%** operation cost reduction yearly **€10 million** saved in the first year	**10%** reduction in crime **10%** less accidents	**23,650** tons of CO_2 reduction annually	**None**

KEY LEARNING

- **Privacy**: the project faced privacy issues and the city worked on balancing between data sharing and personal info protection, according with new GDPR.
- **City brand**: Relationship with city "image" (An advanced lamppost infrastructure is often associated to "technologically advanced" cities)
- **Interoperability** by design, lamppost represents an effective support for a potentially infinite set of services related to urban life

REPLICATION CONDITIONS

- **Political backing** to stimulate city-wide scale project, and maturity (low risk) technology
- **Public ownership** of large enough volumes to bring attractive concession to market
- **International Events:** EXPO 2014 as a driver for the LED full upgrade

INFORMATION SOURCES

- Interview Roberto Norcerino from the City Hall and Alessandro Fellini from a2a Smart City the concessionaire representative and other sources link

5.2.2 Burgas –Small City, Big on Smart and small in volumes

SUMMARY

Burgas owns and operates a stock of 20,000 lampposts. Most are dated and difficult to retrofit.

CITY CONTEXT

The Fourth largest city in Bulgaria in a seaside with historical pedestrian city center.

Size	Development	Politics, Policy Regulation	Culture & Social	City Physiology
~200,000 habitants	Fast developing city going through important societal changes	Covenant of Mayor commitment to energy efficiencies. Streetlight network public own however power only available at night.	Tourist Area during summer only	Seaside city with preserved seafront. Flat Area. Historical Centre. 2 main pedestrian streets. Renovated Post-Soviet infrastructures.

PROJECT

Use Cases	Scale 25%/50%/75%/100% or input # of unit	Implementation		
		Business Model	Financing	Timing
☑ LED	10% upgrade p.a. Plan all	Public Operated	Public – 2000 Lamppost (700,000£)	1 year
☑ CMS	300 end points	Public Operated	Public ~ 60,000£	1 year
☑ MFP (LED; Wi-Fi; CCTV; Wheelchair and mobile charge; AQ sensors; Plant Watering, smart phone charging)	4 MFPs installed	Public Operated Through urban renovation projet	Public ~ 20,000£	3 months
☑ MFP (Wifi; CCTV)	25	Public Operated	Public ~ 25,000£	3 months
☑ Solar PV for light	30	Public Operated	Public ~ 50,000€	2 months
☑ Wi-Fi & CCTV on traditional stock	5% of 20k stock	Public Operated	Public funded	1 year

OUTCOMES

Financial	Social	Environmental	Economic
★★★	★★★★	★★	★
LED delivered 30% energy savings. MFPs: no financial benefits, no advertising revenue, PV solar proved to be expensive to operate (new design & pole)	LED improves safety. MFP increases visitors using the pole and wifi (a monitoring indicator)	(CO_2 savings yet to be calculated)	MFP attracts more people to the city centre, district

KEY LEARNING

- Current columns are old, and it proved hard to add smart elements to them.
- 'Smart' needs a coordinated process across a variety of different stakeholders

REPLICATION CONDITIONS

- Age of Lamppost: replacement requirements influence upgrade choices and budget

INFORMATION SOURCES

- Interview with Jana Koleva (EU Policies and Programmes Department, Burgas Municipality) & Daniela Ivanova (Manager of Innovative Systems Burgas & Smart City Lead) from the city of Burgas

5.2.3 San Diego –Big City and Big on Smart

SUMMARY

San Diego has over 40,000 streetlights in operation and has deployed one the biggest sensor network in the world.

CITY CONTEXT

The 8th largest city in US facing Pacific Ocean

Size	Development	Politics, Policy Regulation	Culture & Social	City Physiology
~1.4m habitants	Strong economy notably in tourism and military	Strong political leadership notably on sustainability and innovation	Tourist Area, great ecology awareness	Seaside city with a skyscraper city center. Dense City.

PROJECT

Use Cases	Scale 25%/50%/75%/100% or input # of unit	Implementation		
		Business Model	Financing	Timing
☑ LED	25% upgrade p.a. Plan all	Public Operated	Public	N/A
☑ CMS	25% upgrade p.a. Plan all	Public Operated	Public	N/A
☑ Sensors (Air Quality; Parking; Public Satefy)	3000 sensors Plan	Public Operated	Public	N/A
☑ CCTV	3000	Public Operated	Public	N/A

OUTCOMES

Financial	Social	Environmental
★★★★	★★★★	★
LED & CMS delivered 2.2millions savings the first year Sensors reduction of investigation cost and lawsuits, cost savings on crime detection	Reduced Gun Violence	(CO_2 savings yet to be calculated)

KEY LEARNING

- The application of sensors was driven by a high criminality rate
- Apply a data policy protection on the use of sensors with no facial recognition, no audio recording, no licence plate recognition and private property

REPLICATION CONDITIONS

- Age of Lamppost: replacement requirements influence upgrade choices and budget

INFORMATION SOURCES

- San Diego Police Department, Presc

NOTE
the full 20% document holds 20 captured case studies